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Sicat PMS

Pantograph monitoring system for overhead contact line systems

The Sicat® PMS pantograph monitoring system enables measurement of the contact wire uplift caused by passing rail vehicles at the support of an overhead line system. These measurements can be used to assess the contact force of the vehicle pantograph. Incorrectly adjusted or defective pantographs on rail vehicles can be detected and automatically reported to the control center.

Features

- Effortless integration of the sensors into existing components of the overhead contact line
- Reliable measured value acquisition by laser sensor even in adverse weather conditions
- Measurement redundancy thanks to optional opto-mechanical angular position sensor
- Simple and reliable train identification by means of RFID technology (optional)
- Measured value transmission to operations control center via rail network infrastructure, such as wide area network (WAN) or radio system

Technical data	Laser sensor	Optomechanical angular position sensor
Nominal voltage	24 V DC	
Perm. ambient temperature, if necessary with heating	-30...+50 °C	-30...+50 °C
Max. running speed	400 km/h	400 km/h
Operating range (uplift)	-50...200 mm	-50...200 mm
Measuring accuracy	±2 mm	±5 mm
Signal	electrical, 4...20 mA	Optical
Nominal power	> 5W	
Electromagnetic compatibility	EMC certified	No impact from optical sensor

Design

Main components

The Sicat PMS pantograph monitoring system consists of one or more trackside inspection gates which are linked via an existing control system to a central computer in the operations control center.

An inspection gate comprises a data acquisition station and an evaluation station.

Measured value acquisition:
- Uplift is measured by means of a laser sensor directly above the contact wire and, optionally, by an potential free optomechanical sensor on the steady arm
- Train detection and speed measurement plus triggering of uplift measurement are performed by two axle counters per track.
- Climate data are acquired by means of wind speed and wind direction sensors and by temperature and humidity sensors. Further climate data acquisition is available as an option

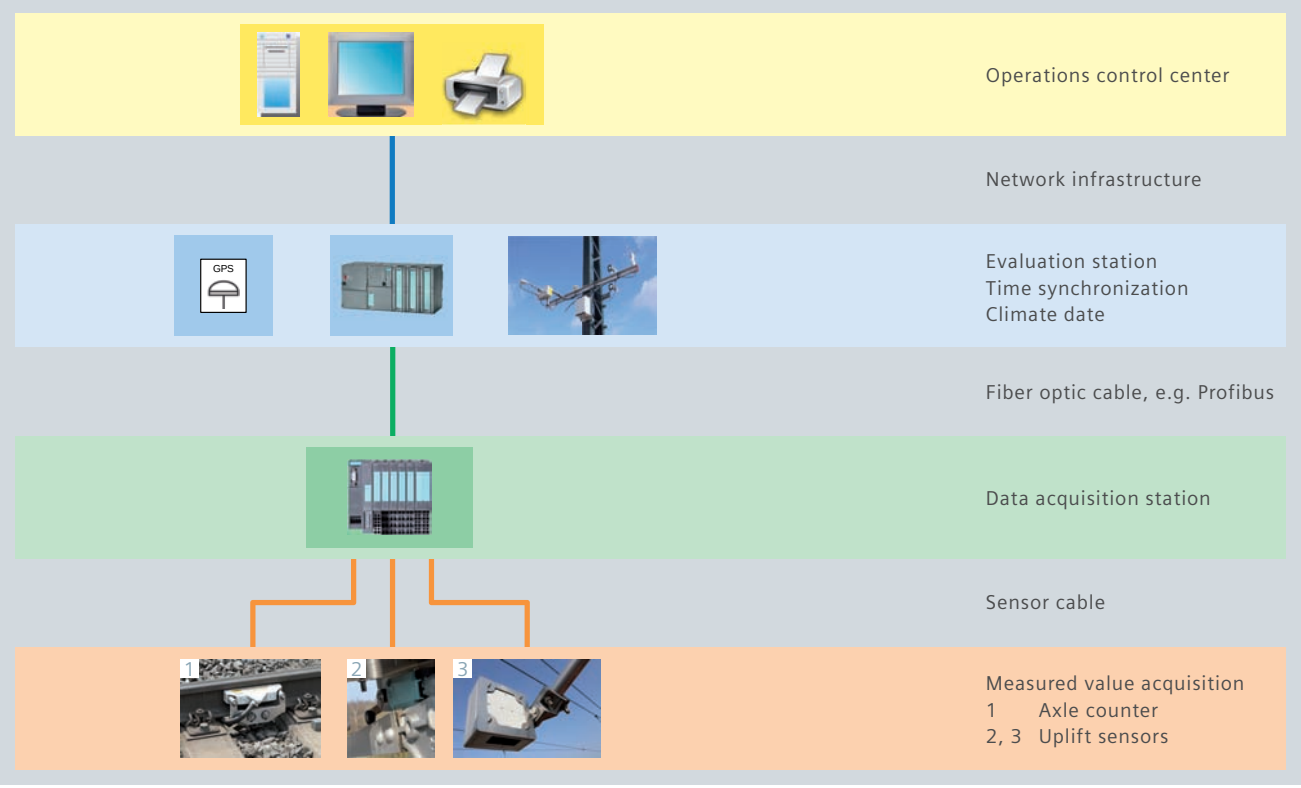
Evaluation station:
- GPS receiver for time synchronization
- CPU for processing measured data
- Communication with operations control center using protocol according to IEC 60870-5-104

The rail network infrastructure, e.g. WAN or radio system, is used for transmitting information and measured values from the individual inspection gate to the operations control center.

Depending on the customer's requirements, the results of the inspection gate data are compiled on a central computer in the operations control center or maintenance center.

System integration and interfaces

To ensure smooth integration into the overall system, Sicat PMS has various interfaces which have to be clarified in advance for each project:
- Fastening of the sensors on the cantilever
- Cable routing between the sensor and data acquisition station
- Installed location of the evaluation station
- Forwarding of data and communication from the evaluation station to the operations control center
- External power supply for Sicat PMS
- Definition of the indicating and alarm thresholds, such as a function of the vehicle type or speed



Topology of Sicat PMS, schematic diagram

Function

Measured value acquisition

Sicat PMS begins with the acquisition of measured values as soon as a train passes the inspection gate. The axle counter transmits a corresponding activation signal to the data acquisition station. Consequently, the uplift and climate data are first acquired and then recorded and processed in the evaluation station. After the train has passed the inspection gate, measured value acquisition is interrupted until the next train passes the inspection gate. The time synchronization system enables identification of rail vehicles with the assistance of documented train routes.

If the trains are equipped with a functioning RFID tag system, optionally trackside installed RFID readers can be used, for example, to identify passing trains in real time. Other train identification systems can also be integrated into Sicat PMS.

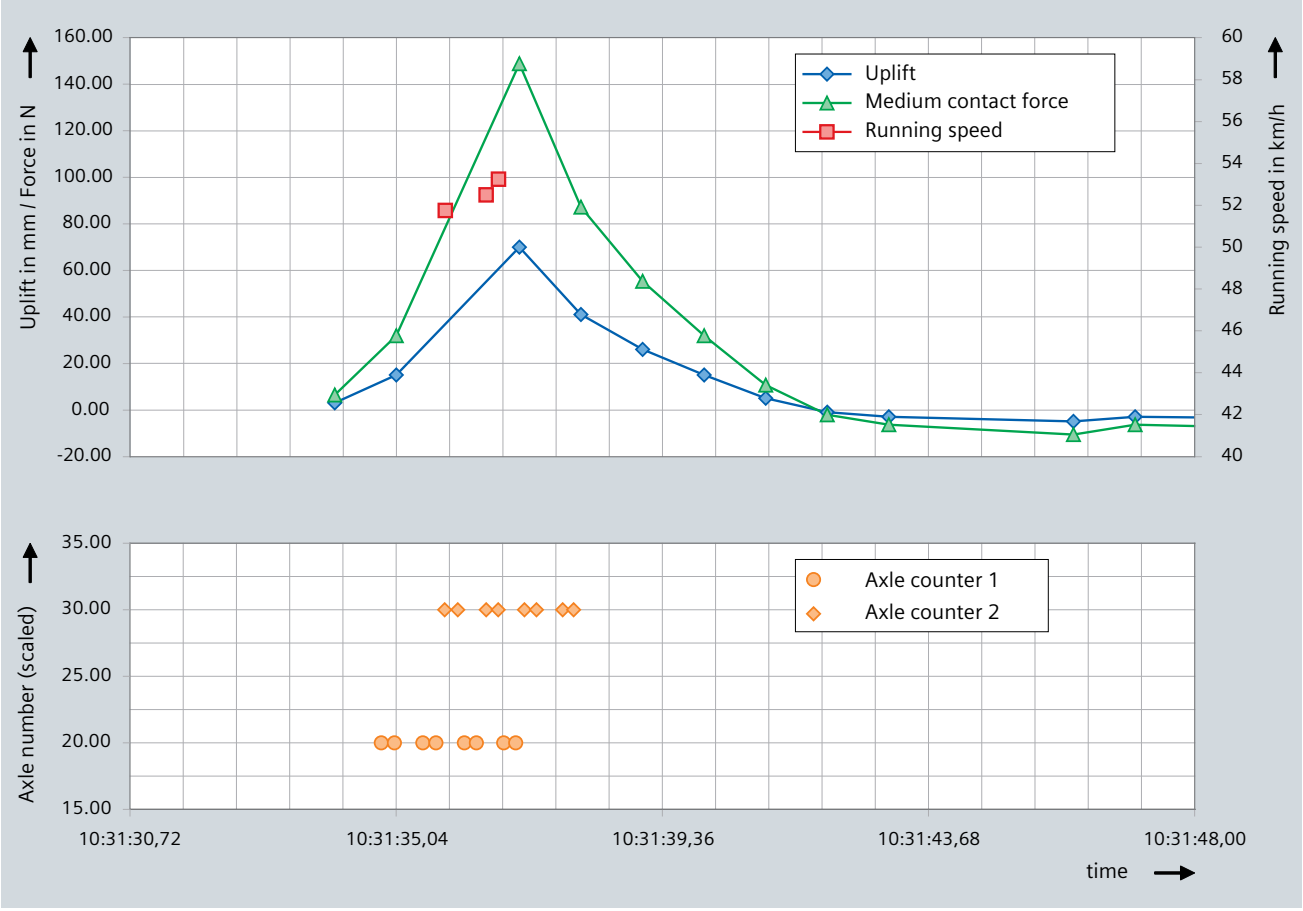
Evaluation and communication

The evaluation station records the measured values of the individual sensors. A programmable logic controller filters and processes the measured values and uses them to determine the contact line uplift at the support in real time. Uplift values exceeding a specified threshold are signaled in the operations control center.

A self-diagnosis function recognizes system errors and component failures and forwards this information to the operations control center.

In the operations control center, the operator receives the following measurement results for the passing rail vehicles as output:

- Location of the inspection gates
- Uplift-time diagram
- Contact force-time diagram
- Wheel axle detection
- Train speed, direction of travel
- Train type
- Pantograph position and number of raised pantographs
- Train ID (optional)



Evaluation diagrams, example of evaluation from Wildenrath Test Center

Fields of application

Philosophy

Progress is continuing to be made in the privatization and internationalization of passenger rail and rail freight traffic, and also in the breakup of enterprises into rail infrastructure companies and rolling stock operators. This has led to increased interest on the part of network operators in strict compliance with the technical specifications for rolling stock within their network.

Monitoring of the pantograph-contact wire interface has therefore taken on a special significance.

Areas of application

Operators of overhead contact line systems and rolling stock maintenance providers can use Sicat PMS in a variety of ways:

Increase system and operational safety
Safety-related concerns prevent trains with defective or improperly adjusted pantographs from running, for instance, on certain sections of track or passing through important tunnels. Sicat PMS detects such pantographs and forwards this information to a control center. The trains concerned can then be stopped or rerouted in time.

Verify damage to the overhead contact line caused by defective pantographs
Defective pantographs can be detected with Sicat PMS. The rail vehicle involved is detected and recorded by means of a unique identification characteristic, such as the train number. Central documentation of the measured data ensures verification of the train involved in case of any damage.

Optimize the cost of operating overhead contact line systems
Measuring the uplift of the contact wire at the support enables conclusions to be drawn with regard to the pantograph contact force. The wear during life-time of the contact wire can be reduced through proper adjustment of the pantograph.

Set up condition-based maintenance of pantographs
An optional contact strip diagnostics function on the infrastructure side enables Sicat PMS to automatically measure the wear allowance of the contact strips during train operation. The contact strips can then be replaced in good time and defects in overhead contact lines can be prevented.

References

Sicat PMS, Wildenrath Test Center, Germany

Long-term test with prototypes
- Motilla–Valencia high speed line, Spain since 2010
- Wildenrath Test Center, Germany since 2011
- e-Highway Templin, Germany since 2011

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